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# A FIELD TRIP TO COAL PREPARATION PLANTS IN EASTERN CANADA, SEPTEMBER 26-30, 1977

G.R. HOEY AND W. DINGLEY

CORROSION SECTION
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# A Field Trip to Coal Preparation Plants in Eastern Canada

September 26 to 30, 1977

by

G.R. Hoey and W. Dingley

Visits were made to Devco's Victoria Junction Coal Preparation Plant (Sydney, N.S.) and to the coal reclamation plant of Thorburn Mining Ltd. (Stellarton, N.S.) with the objective of identifying corrosion and erosion-corrosion problems in coal processing. The identification of these problems will enable CANMET to recommend corrosion control methods and more resistant materials to the industry and to initiate research and development for problems requiring new or improved technology.

## Devco's Victoria Junction Coal Preparation Plant

Personnel: John C. Campbell (Product Engineer)

R. MacPherson (Chief Engineer, North Sydney Plant)

The plant and its operation are described in a paper presented at the Annual General Meeting of CIMM in Ottawa, 1977 by Mr. Campbell. Construction of the coal preparation plant was commenced in 1975 and run-of-mine coal from the Lingan and No. 26 Collieries was first processed in October 1976. The preparation plant is equipped with eight modular units consisting of a desliming screen, heavy medium cyclone, rinsing screen and vibrating centrifuge for each unit (refer to simplified flowsheet). The desliming screens separate the raw coal slurries into 1 1/2 in. x 1/2 mm and minus 1/2 mm fractions.

Page No

The 1 1/2 in. x 1/2 mm fraction is mixed with a finely ground suspension of magnetite in water which then gravitates to a bank of 26-in. DSM primary washing cyclones. The minus 1/2 mm fraction is treated by froth flotation in 300 cu. ft. Wemco Fagergren cells. The modular units are in two groups to process Lingan and No. 26 coal separately (five modules for Lingan and three for No. 26 coal).

Metallurgical coal is separated in the primary washing cyclones and reports to the overflow as a lower sulphur product. Material reporting to the underflow of the cyclones consists of magnetite (heavy medium), thermal coal and refuse. The cutpoint in the cyclone is in the specific gravity range of 1.30 to 1.40.

Magnetite is recovered from the metallurgical coal by passing the cyclone overflow to a bank of sieve bends and low head rinsing screens. Coal leaving the screens is dried to a moisture content of 4.5 to 5% in a series of Siebtechnik centrifugal driers. The metallurgical coal product from Lingan and No. 26 Colliery coal contains approximately 1.2% sulphur, 3% ash and 7.5% moisture.

Primary heavy medium is recovered from the underflow of the primary cyclones by passing the material over a two-stage bank of DSM sieve bends. The underflow is then combined with heavy medium of specific gravity 1.60 to 1.65 and pumped to secondary heavy medium washing cyclones. Thermal coal reports to the overflow and refuse reports to the underflow of the

secondary cyclones. Magnetite is recovered from the thermal coal and refuse before they are dried in centrifuges.

The circuit for recovery and concentration of heavy medium consists of primary and secondary magnetic separators, DSM thickening cones and screens. The circuit was designed to recover 99.9% of the magnetite fed to the coal circuit but losses amount to 2 pounds per ton of coal processed. The losses occur in the secondary separator effluent and by adherence to coal. Raw magnetite (55% minus 325 mesh) is batch milled to a specification of 95% minus 325 mesh and sufficient milled magnetite is added to the heavy medium circuit to maintain coal production at the required level.

Flotation collector reagent is added to the minus 1/2 mm coal fraction from the desliming screens and the two flows, one from the Lingan circuit and the other from the No. 26 circuit, are fed to six-cell and four-cell flotation circuits, respectively. A frothing agent is added to the flotation cells. The froth is collected in holding tanks and then dried in screen bowl centrifuges. The dried coal is dropped onto metallurgical coal and thermal coal conveyors. The high ash refuse from the flotation cells is treated with a flocculating agent and then it flows to a 125-ft thickener. The overflow water from the thickener is reused in the plant while the thickened sludge is pumped to settling lagoons. The plant water flow was originally designed for a closed circuit but increase of chloride in the water resulted in plant modifications.

To stabilize the chloride concentration at a level of 2500 ppm, about 500 gal/min of water is bled from the plant and treated before it is discharged into a stream. Potable water is used for make up. The chloride increase was traced to the presence of 0.1% chloride in the raw coal.

The plant is designed for the processing of 475 tph of Lingan and 275 tph of No. 26 raw coal. About 95% of the coal product is metallurgical grade and the remainder is thermal grade coal.

Mr. Campbell stated that corrosion is a serious problem in the plant. Schedule 80 pipe at the pump discharge from heavy medium cyclones has been replaced after 3 months of plant operation. Cyclones have been replaced after 4 months' service due to erosion-corrosion. Severe wear of impellers and housings of Worman Ni-hard pumps and of screen bowl centrifuges and discharge screens has occurred in less than a year.

Excessive maintenance and replacement of equipment in the first year of operation of the Victoria Junction Plant caused Devco to obtain the services of a water treatment company. Corrosion coupons have been installed by this company in a cooling waterline to determine the aggressiveness of the water. These tests were commenced in late August and have not been completed. Since the tests are being conducted on clarified water, they do not simulate erosion-corrosion of equipment caused by flowing slurries of coal, magnetite and refuse. The pH of the process water is maintained in the range 7.5 to 8.0 by addition of

lime or caustic soda. This range is optimum for corrosion control in cooling water systems but not in aqueous slurry systems.

Water analyses conducted by Environment Canada are presented in Table 1. These analyses show that the chloride and sulphate concentrations of the make up water (freshwater process) are increased during processing of the coal. If the increase of sulphate concentration is caused by oxidation of pyrite in the raw coal, thiosalts would be present in the process and effluent waters. Research in the Corrosion Section, PSL has shown that thiosalts accelerate corrosion of carbon steel.

Raw coal from the Prince Mine was washed at the Victoria Junction Plant for a short period of time. This coal has a sulphur content of 4 to 6% and caused acidification of the process water and other processing problems. Prince Mine coal is now washed at the North Sydney Coal Preparation Plant. The plant was not visited but its corrosion problems were discussed with Mr. MacPherson and Mr. Campbell.

The North Sydney Plant is a jig plant built in 1950. Plant production is 150 tph but it can process up to 350 tph of raw coal. Washing of the raw coal reduces the sulphur content of Prince coal to 3.7%. Caustic soda has been added to the process water to maintain a pH of 7.5. Without pH adjustment the pH has reached a value as low as 3.8 due to oxidation of pyrite in the coal. Mr. MacPherson stated that

Table 1

Water Analyses by Environment Canada

| Date Collected | Sampling Location | pH | $Cl^-$ ppm | $SO_4^{-2}$ ppm |
|---|---|---|---|---|
| 05/07/77 | freshwater process | 7.7 | 210 | 127 |
| 05/07/77 | final effluent | 7.8 | 1550 | 393 |
| 05/07/77 | clearing sump | 7.5 | 2100 | 304 |
| 05/07/77 | lower end holding pond | 7.6 | 225 | 287 |
| 05/07/77 | runoff waste rock | 7.9 | 1450 | 637 |

wear in the plant is severe. Pump impellers fail in 1 1/2 weeks, screens (3/4 inch) in 3 months and 12-in. pipe in 6 months. A water treatment company was contacted by Devco in September concerning treatment of the process water.

Stellarton Coal Reclamation Plant operated by Thorburn Mining Ltd.

Personnel - Mr. C.E. Carr (plant manager)

Mr. Avery (process control)

The Stellarton coal reclamation plant is engaged in reclaiming coal from three coal mine waste dumps in the area.

The plant is funded by the Nova Scotia government to (a) recover coal (25%) from the waste dumps, (b) provide employment for unemployed local miners and (c) provide thermal coal for power generators in Nova Scotia. The plant is an old screen and Disac jig wash plant that has been put back into production. A 24-in. compound water cyclone (CWC) circuit has been added to recover the minus 1 3/4 plus 3/16-in. coal and a 6-in. cyclone circuit to remove the minus 3/16-in. fine reject material from the recycled water supply. The reclaimed coal contains less than 1% sulphur and 20 to 22% ash (refer to flow-sheet).

The waste material from the dumps is hauled in trucks to the reclamation plant where it is weighed, crushed to minus 6-in. and passed over a primary screen to separate it into two fractions, overflow minus 6 plus 3/4-in. and underflow minus 3/4-in. The first fraction is hand picked to remove debris, rock and shale as it is conveyed to the Disac jig which operates at a specific gravity of 1.3. The overflow from the jig (coal) is screened to obtain three fractions, minus 6 plus 3/4-in., minus 3/4 plus 3/16-in. and minus 3/16-in. The first fraction is conveyed to the coarse coal product bin, the second to the fine coal product bin and the third goes with the excess water to a drag tank. The underflow from the jig is conveyed to a refuse bin.

The underflow from the primary screen goes to a dual mixing tank where water is added from a header tank. The resulting

slurry is pumped to the 24-in. CWC. The overflow (coal) from the CWC goes to a screen which separates it into three fractions, minus 1 3/4 plus 3/4-in., minus 3/4 plus 3/16-in. and minus 3/16-in. The first is conveyed to the coarse coal bin, the second to the fine coal bin and the third to a drag tank. The underflow from the CWC is screened to remove the minus 1 3/4 plus 3/16-in. fraction which is conveyed to the coarse reject bin. The underflow from the screen goes to the drag tank. Overflow from the drag tank goes to a holding tank or to the settling pond. Water containing considerable fine reject material is pumped from the drag tank to the header tank for recycling. The fine and coarse coal and fine and coarse reject material are transported on four drag conveyors to their respective bins. Excess water has a chance to drain away from the coal and reject material during this conveying process.

A drag conveyor also operates from inside the drag tank to remove sludge which accumulates on the bottom and conveys it to a centrifugal drier where excess water is removed prior to conveying it to the fine reject bin. The slurry in the holding tank is pumped to a 6-in. cyclone where the overflow goes back to the holding tank and the underflow is screened. The overflow (fine reject) from the screen goes to the centrifugal drier in winter and direct to the fine reject bin in summer. The underflow goes back to the drag tank. Reject material is weighed and returned to the waste dump and the coal is weighed and stockpiled ready for shipment.

During the plant tour Mr. Avery pointed out the locations of severe wear and provided the following information:

1. Disac jig plates were replaced every 3 to 4 months.
2. The lower cone in the compound water cyclone was replaced every 6 months and the vortex finder once a year.
3. Severe wear causes holes in pipe walls particularly at bends and at joints made with victaulic couplings.
4. Mild steel screen panels on #3 screen were replaced every 6 weeks at a cost of $100 per panel plus labour and lost product costs. A panel with plastic (tyrethane) screen had been installed at a cost of $2500 and was still in operation after 1 year. More plastic screens were being purchased.
5. Pumps with Ni-hard liners and impellers were replaced after 4 years whereas a rubber lined pump lasted 2 weeks.
6. Conveyor links and base plates were repaired or replaced frequently due to wear. There was always more wear where the equipment was constantly wet. Parts failed less frequently in damp areas. The severest wear was occurring where the conveyor links went over the crown at the top of a rise. A steel with more wear resistance has been ordered for these areas.
7. Perforated panels in the cone of the centrifugal drier were replaced frequently due to wear. The perforated panels were made of stainless steel sheet.

8. Hard surfacing applied by arc welding had reduced wear substantially in some areas. The welding material was #224 Sodel hard surface rods.

Samples of water were obtained from the following four locations: (a) local water supply, (b) Disac jig, (c) drag tank and (d) plant effluent. The pH's of these samples were 6.8, 6.9, 6.9 and 7.0, respectively.

The wear occurring in this plant is caused by erosion-corrosion. The installation of the plastic screen in place of a mild steel screen and the use of hard surfacing demonstrate that wear can be reduced by using more abrasion and corrosion resistant materials.

This reclamation plant would be an excellent location to test erosion-corrosion control methods developed in the laboratory in view of the fact that the process would not be significantly affected by the introduction of chemical additives for pH control and/or corrosion inhibition.

## CONCLUSIONS

The plant visits in Eastern Canada confirm earlier findings[1] that wear (erosion-corrosion) leads to premature failure of equipment and increased maintenance costs in coal preparation plants. Staff at the Victoria Junction and Stellarton Plants is aware of these problems but the technology is not available to solve them. The corrosion survey indicates that wear in wash plants can be reduced by new or improved water treatment methods and by better choice of materials.

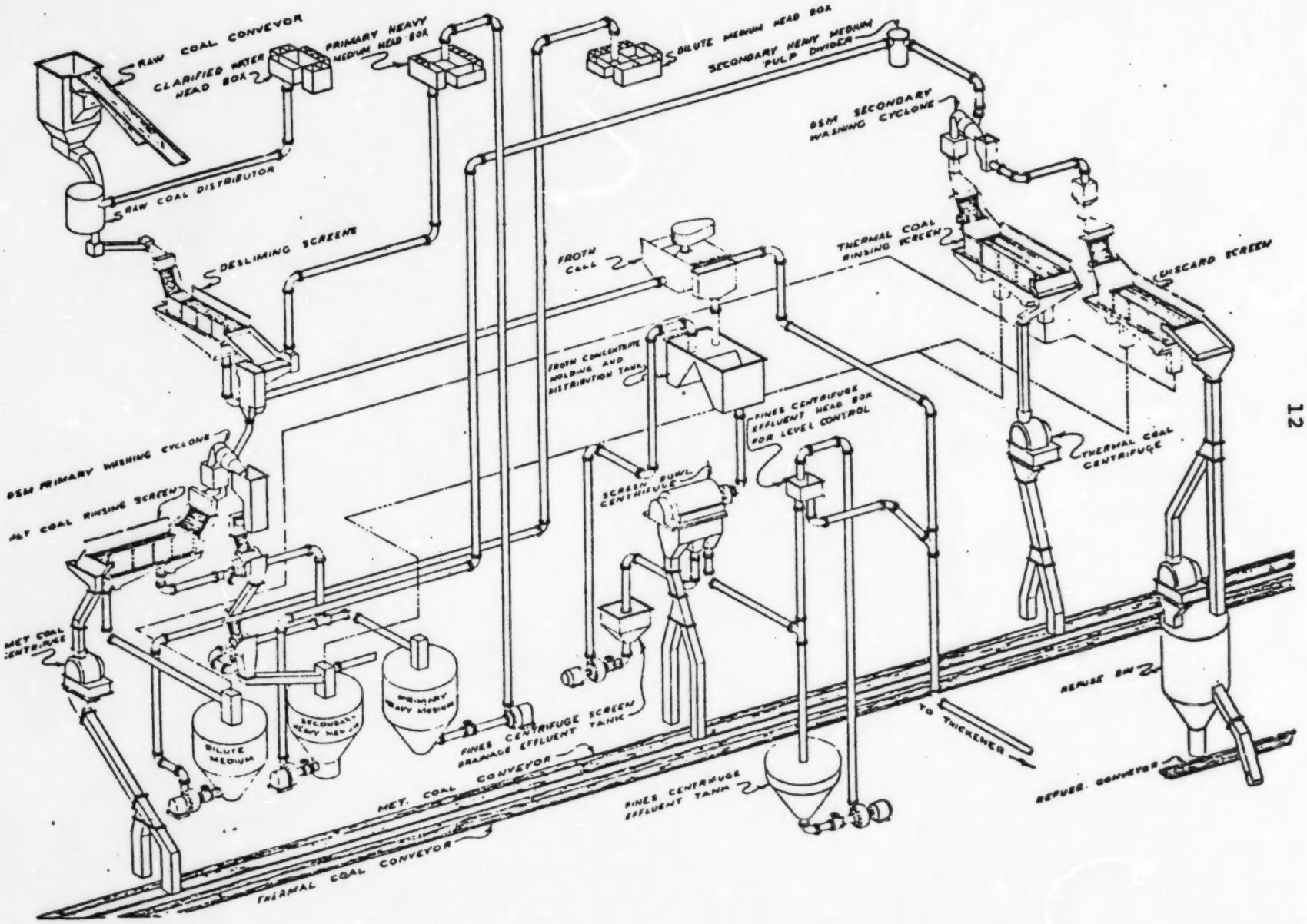
Page No.

## REFERENCE

(1) W. Dingley and G.R. Hoey, A Field Trip to Coal Processing Plants in Western Canada, February 28 to March 4, 1977: ERP/MSL 77-148 (FT).

# VICTORIA JUNCTION COAL PREPARATION PLANT

(simplified flowsheet)



# FLOW CHART

THORBURN MINING LTD.